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During the Cassini-Huygens probe mission at Titan on 14th January 2005, The Huygens Atmospheric Structure instrument (HASI) performed in situ measurements of the physical and electrical properties of the atmosphere and the surface along the entry and descent trajectory and at the landing site.
The atmospheric profile along the Huygens probe trajectory during entry phase was retrieved from the accelerometers data, while below 160 km direct pressure and temperature measurements were performed. The atmosphere was detected by HASI at an altitude level of about 1500 km; pressure and temperature vertical profiles were retrieved starting from the exobase (estimated to be at $\sim$1380 km) using the assumption of hydrostatic equilibrium. The upper atmosphere was warmer than predicted [Yelle et al. 1997]; several temperature variations have been observed in thermosphere possibly related to inversion layers and other dynamical effects such as gravity or tidal waves [Strobel, 2006]. The virtual absence of the mesosphere and the wave-like nature of the temperature profile suggest that the region in Titan's atmosphere above 250 km may not be dominated by radiative processes and may be strongly influenced by wave activity.
The stratopause, which was detected near 250 km, had a temperature of $\sim$187 K and a pressure of about 0.3 hPa. The temperature structure of the lower atmosphere is in very good agreement with the Voyager 1 RSS and IRIS measurements [Lindal et al. 1983, Lellouch et al. 1989]. The tropopause, at the altitude level of $\sim$ 44 km (at pressure of 115$\pm$1hPa) had a temperature of (70.43$\pm$0.25)K.
The meteorological conditions monitored at the surface of Titan for almost half an hour, resulted in a mean value of temperature of 93.65$\pm$0.25 K and pressure of 1467$\pm$1 hPa.
Meterological interpretation of HASI data leaded to the determination of the presence of a weakly convective Planetary Boundary Layer (PBL) of 300 m [Tokano et al. 2006] also confirmed by the correlation with Huygens DWE data.
The electrical properties, as the permittivity at 45 Hz and the conductivity, of the atmosphere have been measured during the whole descent phase and at the surface of Titan by the Permittivity, Wave and Altimetry package (PWA) sensors. An ionized layer was detected at altitudes above 50 km, using two independent techniques, and the presence of free electrons in the upper atmosphere was confirmed. The relative dielectric constant of Titan's surface material is nearly 2 and the electric conductivity $4\times10^{-1}0$ S m^{-1} [Grard et al. 2006].
The temperature and density profiles inferred by HASI are of great value since they provide: a) an accurate determination of the whole atmosphere (from ground up to exobase); b) the only new and independent definition of the tropospheric thermal structure; c) atmospheric parameters based on very precise characterization of the chemical structure.
An overview of the results concerning the atmospheric structure, electricity and meteorology will be presented and discussed in relation with the results of ground based and remote sensing observations by Cassini in this last decade.